Center for Independent Experts (CIE) Independent Peer Review Report

On

2020 Benchmark Stock Assessment for Maine Hawaiian Islands Uku

Prepared by

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I. Executive summary

The External Independent Peer Review under the Western Pacific Stock Assessment Review framework for the 2020 Main Hawaiian Islands (MHI) Uku, *Aprion virescens* (family Lutjanidae), Benchmark Stock Assessment was held in Honolulu, HI from February 24-28, 2020. The Review aimed to evaluate input data, stock assessment model configuration and parameterization, stock assessment outputs, model projection, and uncertainty associated with the assessment. The Review also needed to determine if the benchmark stock assessment is appropriate and adequate for providing management recommendation for the MHI Uku and make according recommendations for the improvement of the stock assessment modeling and assessment process.

Using mostly fishery-dependent data and compiling and collecting some key life history data, the Assessment Team configured and parameterized an integrated statistical catch-at-age model implemented in Stock Synthesis (SS) 3 (v. 3.30S) for the MHI Uku stock. The assessment is the first SS-based species-specific benchmark stock assessment for Uku. Pacific Islands Fisheries Science Center (PIFSC), West Pacific Stock Assessment Review (WPSAR) and West Pacific Fisheries Management Council (WPFMC) provided all the necessary logistics support, documentation, input and output data, and background information I requested prior to and during the Review. The Assessment Team was open to suggestions, provided additional information upon request, and conducted additional model runs for more sensitivity analyses identified by the Review Panel during the review. The PIFSC Assessment Team accommodated all requests I made for different test runs and extra information. The whole process was open and constructive, and all materials were sent to me in a timely manner. As a CIE reviewer, I was charged to evaluate the 2020 Benchmark Stock Assessment for Main Hawaiian Islands Uku with respect to the Terms of Reference.

I would like to commend the NOAA PIFSC Assessment Team's efforts in the MHI Uku review for excellent documentations on the model input data, CPUE standardization modeling configuration, stock assessment model configuration and parameterization, biological/statistical assumptions, model projection, and determination of fish stock status. I was impressed by the breadth of expertise in the review, the amount of effort spent to compile all the data for the assessment, the considerations of plausible scenarios for sensitivity analyses, the openness of discussion on stock assessment uncertainty, the consideration of alternative approaches and suggestions, and the constructive dialogues among the Review Panel, Assessment Team and other participants during the review.

Overall, based on the stock assessment presented and additional runs conducted during the review, I believe that the assessment results and Uku stock status determination are robust regarding various uncertainties in data, parameters and assessment models. The 2020 benchmark stock assessment concludes that the MHI Uku stock is currently NOT undergoing overfishing and is NOT overfished. Comprehensive sensitivity analyses suggest that this conclusion is rather robust to the uncertainty in the data and stock assessment models. The assessment is scientifically sound and adequately addresses management needs. I recommend that the stock assessment results for the base case scenario identified by the Assessment Team be used for providing management advice. I provide a list of short-term research recommendations for the Assessment Team to consider in improving the draft Uku stock assessment report. These short-term recommendations mainly include providing additional tables and figures to better document, present and summarize data and stock assessment results; conducting additional sensitivity analyses to evaluate alternative input data and model configuration and parameterization; and improving model projections to better capture assessment uncertainty. I believe these recommendations can greatly improve this MHI Uku benchmark stock assessment. I also provide the mid-term and long-term research recommendations to further improve the quality of recreational catch data and life history parameter estimates, explore more alternative model configurations and parameterizations, and better understand temporal variability in the fishery. My specific short-, mid-, and long-term research recommendations/comments can be found in TOR 10.

II. Background

The Uku Snapper, *Aprion virescens* (family Lutjanidae), or sometime referred to as the Gray Snapper or Green Jobfish, can be found throughout the Hawaiian Archipelago extending 2600 lm along a SE-NW axis from 19N, 155W to 28N, 178 W. This region is typically divided into two broad regions: the inhabited main Hawaiian Island (MHI) and the mostly uninhabited Northwestern Hawaiian Islands (NWHI). Uku is a coastal semi-pelagic species and inhabits the water column above a wide variety of habitats usually at depths ranging from 20 to 200 m (Pyle et al. 2016, Asher et al. 2017).

The Hawaiian Uku was managed as a “Non-Deep 7 Bottomfish” until 2019. Uku is managed jointly by state and federal agencies, with catch from state and federal waters counting towards ACL. The Western Pacific Fishery Management Council coordinates the assessment and management processes with the active participation of the industry, Pacific Islands Fisheries Science Center, academic institutions, state management agencies, and other federal agencies including the NOAA Office of Law Enforcement and the US Coast Guard. The management follows Magnuson-Stevens Conservation and Management Act to achieve the following management objectives: preventing overfishing, rebuilding overfished stocks, increasing long-term economic and social benefits, and ensuring the safe and sustainable supply of seafood.

The stock structure of Hawaiian Uku is still not well defined, with limited information on larval connectivity and adult movement between the MHI and NWHI. Uku stock connectivity within the MHI is also not clearly defined. However, the MHI and NWHI reef fishes have limited larval and adult exchanges given the dominant current direction and the large distances, and are considered to belong to different stocks (Toonen et al. 2011, Wren et al. 2016). Based on recent studies on passive pelagic connectivity in the MHI and current management stock definition, it appears that a stock assessment on the scale of the MHI is appropriate. This assessment evaluates the MHI Uku stock dynamics from 1948 to 2018.

Before this assessment, the MHI Uku stock was defined as “not overfished” in 2013 using a catch-only method applied to the family level (Sabater and Kleiber 2013) and then in 2017 was determined using a length-based mortality model and a simple population dynamic model to not have been experiencing overfishing on a species level (Nadon 2017). This stock assessment is the first formal quantitative stock assessment using an integrated stock assessment model (i.e., Stock Synthesis 3.30; Methot and Wetzel 2013) for the Uku.

Commercial Uku landing data were compiled from records in the Fisher Reporting System (FRS) from the State of Hawaii’s Division of Aquatic Resources. This database includes self-reported catch in numbers and weights per record at the species level, with records correspondingly approximating individual trips. The FRS includes landings beginning in January 1, 1948. The FRS dataset was used to yield annual CPUE indices and commercial catch from 1948 to 2018, corresponding to the first and terminal years of this assessment, respectively. The commercial landings were classified as four-gear groupings perceived to have different size selectivities including (1) deep-sea handline; (2) inshore handline; (3) trolling, and (4) other gears.

The recreational Uku fishery data were obtained from the Hawaii Marine Recreational Fishing Survey (HMRFS) conducted by the Hawaii Division of Aquatic Resources and NOAA Fisheries Marine Recreational Information Program since 2003 (MRIP, Ma and Ogawa 2016). The recreational catch in this database was estimated by combining total fishing effort obtained through phone interview (replaced by mail survey in 2018) and through onsite fisher interviews for CPUE for boat- and shore-based recreational fishing activities.

The fishery-independent survey index was obtained from the Pacific Reef Assessment and Monitoring Program (RAMP) SCUBA diver survey conducted by the PIFSC every 2 to 3 years starting in 2005.

This assessment uses Stock Synthesis (SS) 3 (v. 3.30) as a modeling platform for assessing the Uku stock. The following data were compiled for the SS model in the assessment: life history data (e.g., size-at-age, natural mortality, length-specific maturity, and weight-length data); landings that include commercial fisheries (i.e., landings for deep-sea handline, inshore handline, trolling and others); landings from the recreational fishery; weight composition of deep-sea handline landings from 1948 to 2018; four standardized fishery-dependent abundance indices (i.e., commercial deep-sea handline CPUE with "fishing day" as effort unit 1948-2002, commercial deep-sea handline CPUE 2003-2018, inshore handline 2003-2018, and trolling 2003-2018).

A base case scenario was developed during the WPSAR Uku Assessment. Multiple scenarios were developed for sensitivity analyses with respect to recreational landings estimated using different methods, inclusion/exclusion of standardized CPUEs of certain commercial fishery/gear, steepness parameter, natural mortality rates, effective sample sizes for deep-sea handline weight composition data, and parameters determining recruitment dynamics (sigma R).

Length-based selectivities were assumed to follow logistic curves for all commercial fisheries/gear and recreational fishery. Only the deep-sea handline selectivity was estimated in the SS model, and the selectivities for all other gears/fleets, including inshore handline, trolling, other gear and recreational fishery, were estimated outside of the SS3 using a length-based spawning potential ratio (LBSPR) model (Nadon et al. 2020). The selectivity was also fixed for the diver survey. Selectivity defined in this assessment includes both gear selectivity and fishery availability due to limited spatial coverage of fish by different fishing gears/fleets. Selectivity patterns were assumed to be constant over time for each fishery and survey time series (except for commercial deep-sea handline because it changes the effort unit from "fishing day" prior to 2003 to "fishing hour" after 2003).

The Pacific islands fisheries are managed under one of the five Fishery Ecosystem Plans. The Uku fishery is managed under the Hawaii Fishery Ecosystem Plan. The minimum stock size threshold (MSST) is set at c^*B_{MSY}, where c = 1-M when natural mortality M is lower than or equal to 0.5 or c=0.5 when M is higher than 0.5. The maximum fishing mortality threshold (MFMT) is set at F_{MSY}. The exploitation and stock status were determined based on a comparison of current deterministic fishing mortality and stock biomass estimates versus MFMT and MSST, respectively.

This review is the first CIE review for the SS3-based species-specific stock assessment for the MHI Uku. I was provided with all the necessary logistics support, documentation, data, and background information. The NOAA PIFSC Assessment Team involved in the process were open to suggestions and provided additional information and analysis upon request. The WPFMC, WPSAR and PIFSC scientists and managers presented the Uku stock assessment and related information, and an industry representative also presented the history of the fishery. The PIFSC Assessment Team worked hard to accommodate all requests the Review Panel made for additional model runs and information. The whole process was open and constructive.

As a CIE reviewer, I was charged with evaluating the 2020 benchmark MHI Uku stock assessment with respect to the Terms of Reference. This report includes an executive summary (Section I), a background introduction (Section II), a description of my role in the review activities (Section III), my comments on each item listed in the Terms of Reference (ToRs, Section IV), a summary of my comments and recommendations (Section V), and references (Section VI). The final part of this report (Section VII) includes a collection of appendices including the Performance Work Statement.

III. Description of the Individual Reviewer's Role in the Review Activities

My role as a CIE independent reviewer is to conduct an impartial and independent peer review of the 2020 benchmark Uku stock assessment with respect to the defined Terms of Reference.

I received the relevant working papers and background materials two weeks prior to the review in the West Pacific Fisheries Management Council in Honolulu, HI. I also received all relevant background information. More background information, all the presentation slides, and results for additional runs were also provided during the review.

I read the draft 2020 benchmark Uku stock assessment report, background information papers and reports, and other relevant documents (e.g., previous review reports) that were sent to me (see the list in the Appendix I). I have also searched, collected and read references relevant to the topics covered in the reports and the Performance Work Statement (PWS) prior to my trip to the Uku stock assessment review meeting.

The review was held from February 24 to 28, 2020 in the WPFMC in Honolulu (see Appendix II for the schedule). The five days of review were attended by the PIFSC fisheries stock assessment scientists, WPSAR and Council representatives, WPFMC SSC member (chair), a state agency representative, two CIE reviewers, and a commercial-recreational fisherman (see the List of Participants in Appendix III).

Presentations were given during the Review on stock assessment input data, information on model configuration and parameterization, fisheries management, stock assessment modeling outputs and results, sensitivity analysis scenario settings and results, results of additional model runs identified during the Review, and model projections (see the list of presentations in Appendix I). I was actively involved in the discussion during the Review by (1) questioning and asking for clarification on monitoring/sampling program designs, statistical analyses, model configuration, assumptions, uncertainties of various sources, and interpretations; (2) commenting on the assessment and review processes; (3) making constructive comments and suggestions for alternative approaches and additional analyses; and (5) contributing to the Review Panel summary report. I had also been interacting with relevant scientists and other panel members regarding issues raised during the review process for further clarifications and discussion during the Review.

During the Review, the Review Panel worked with the PIFSC Assessment Team to develop a series of additional scenarios to evaluate the impacts of various input data compilations and model configurations and parameterization on the stock assessment. The scenario design follows the following principle: changing one variable at a time to ensure that changes observed in modeling can be solely attributed to the change we made. The following additional information and analyses were requested during the review:

Presentation of information:

- Provide fishing mortality estimates for each gear/fleet
- Plot growth curve with NWHI vs MHI indicated and evaluate how growth curve changes with only MHI data
- Provide figure of diver survey locations through time
- Add BMSY/FMSY reference lines to sensitivity plots
- Provide Mohn's rho for recruitment
- Plot observed vs expected catch by gear/fleet
- Provide a summary table for key biological reference points and management statistics for the base case and all sensitivity scenarios
- Provide a summary table on key biological and statistical assumptions made in the stock assessment modeling

Further Analyses:

- Evaluate the effect of removing diver survey abundance data from the model
- Compare CPUEs using old vs new effort measures (i.e., "fishing day" vs "fishing hour") for >=2003 time period to evaluate the impact of new effort calculation [hrs vs reporting days].
- Calculate CPUE time series for inshore handline from 1992-2018
- Start the model with a more recent year (e.g., 1970) to see whether this lack of early data (which tends to be less reliable) may influence model scaling
- Investigate how MSY was calculated (is it exact or proxy?)
- Incorporate iterative effN estimation
- Estimate sigma_R within the model
- Include age-specific natural mortality

Projections:

- Composite selectivity weighted by the proportion of catches of different fleets/gears/sectors in 2018

- Develop a worst-case scenario for recruitment with recruits in the projection being randomly resampled from the bottom 25th percentile of historical recruitment values.

These additional information and analyses were provided to further improve our understanding of model fitting, impacts of uncertainty in data and models, robustness of the assessment results, and/or better present the results of the stock assessment.

I was actively involved in developing additional sensitivity scenarios, discussing outputs and their implications, and identifying issues related to sensitivity runs. I also discussed relevant issues with the fellow reviewers.

IV. Summary of Findings

My detailed comments on each item of the ToRs are provided under their respective subtitles from the ToRs (see below).

1. Of the data considered for inclusion in the assessment, were final decisions on inclusion/exclusion of particular data appropriate, justified, and well-documented?

Yes with caveats, the final decisions on inclusion/exclusion of particular data are appropriate, justified and well documented.

Overall, the data included in the assessment were carefully evaluated for their quality and quantity, and the choices made for the assessment input data were appropriate, justified, and well documented. Rigorous criteria were developed to filter the data, and the filtered data were carefully evaluated for their biological/fishery realisms. The assessment team should be commended for their excellent job in identifying, developing and reconstructing historical commercial and recreational fisheries data. However, I have some concerns regarding how the historical recreational fisheries data were reconstructed.

The assumption associated with the approach used (i.e., the ratio of the mean 2003-2007 recreational catch to the human population size is the same as the ratio of recreational catch to human population size in any year from 1948 to 2018) is not realistic and this ratio of recreational catch and human population was unlikely constant throughout the stock assessment period. Although alternative approaches were explored in sensitivity analyses, neither of them were satisfactory. Given the importance of the recreational fishery for this species, it is important to realize that the uncertainty associated with the historical recreational catch estimates was unknown and not fully considered in the stock assessment results. However, given the results of the study, such an uncertainty is unlikely to change this assessment conclusion about the stock status.

The commercial fisheries data are self-reported by fishermen with some effort for quality control and evaluation. Although I suspect there are still issues on data quality, they should be appropriate for the stock assessment. The nominal CPUE time series for different fishing gears/fleets all showed a noticeable shift in the year of 2003 when the measurement of fishing effort changed from fishing days to fishing hours (and thus became more accurate). However, after a close evaluation, it is clear this shift was real, not an artifact of changes in fishing effort measurements. The size composition data provide critical information on selectivity and population dynamics, and they were well-compiled and documented for the deep-sea handline fishery. However, the size composition data for other fishing gears/fleets (e.g., inshore handline and trolling) were considered insufficient for the use in the assessment, although limited information was provided.

Better documentations may be necessary to justify the exclusion of these data from the stock assessment. In this stock assessment, inshore handline CPUE were calculated from 2003, but there is enough information to extend this data set to years prior to 2003. The assessment team can consider including inshore handline CPUE data from 1992. The assessment team can also consider that deep-sea handline CPUE has a single CPUE time series from 1948 to 2018 using fishing day as an effort measurement ("fishing day" was used prior to 2003, and "fishing hour" after 2003). However, sensitivity analysis conducted during the review suggests that using different fishing effort measurements has little impact on assessment results (Figure 1).

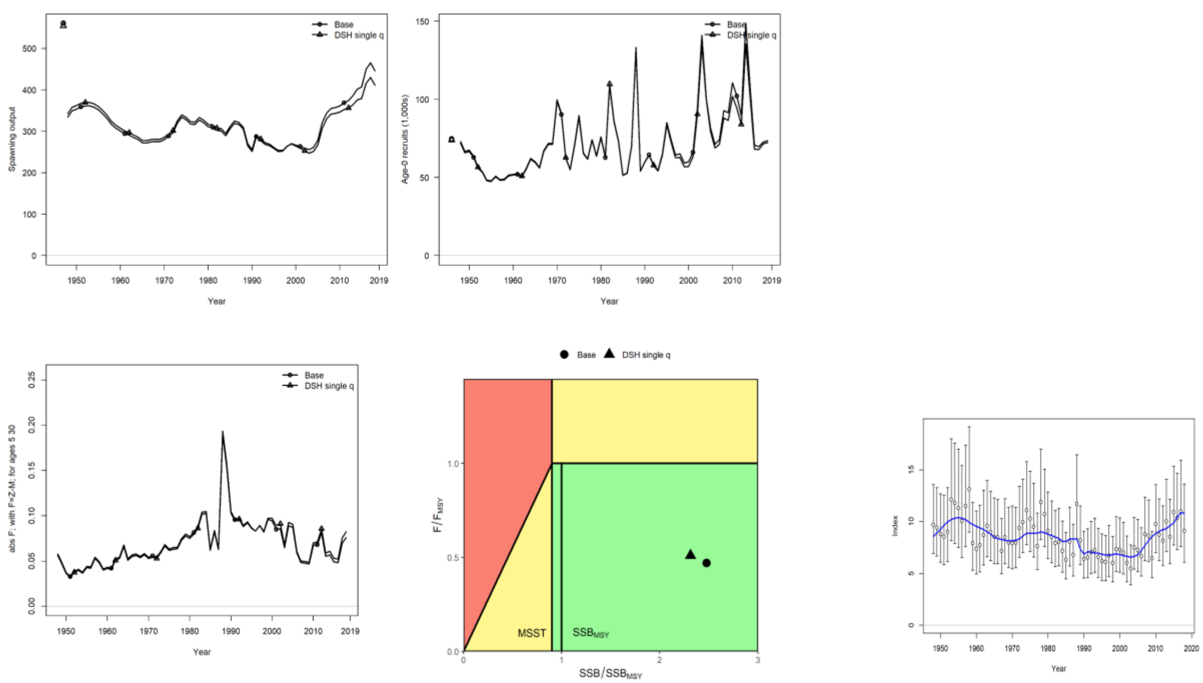

Figure 1: Comparisons of SSB, recruitment, and fishing mortality estimates for the base-case and the sensitivity case with deep-sea handline as single time series.

The diver survey index is the only fishery-independent abundance index in the assessment. Because of its relatively short time period and large uncertainty, it provides limited information on stock dynamics. Little difference can be found for the model runs with and without the diver survey index (Fig. 2). However, with additional data and improved sampling intensity, this survey index has the potential to play a more important role in cross-checking the fishery-dependent data. I would like to encourage further development toward optimizing the diver survey program.

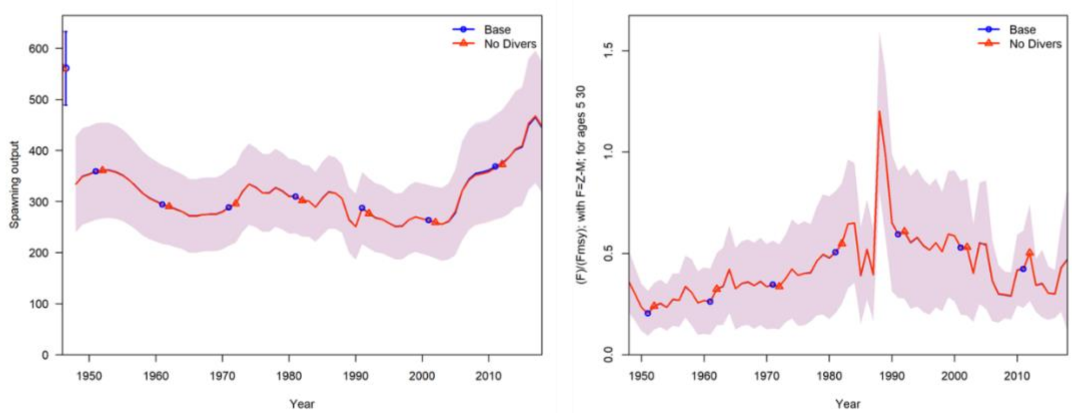

Figure 2: Estimates of SSB and relative fishing mortality for models with and without the diver survey index.

The life history data, which includes growth, were collected from the local study area directly relevant to this species and provide excellent biological information in modeling the population dynamics of the targeted fish stock. I would like to encourage the continuation of local life history studies. The spatial variability in life history data was carefully evaluated in particular growth, but I would suggest evaluating possible temporal variability in key life history parameters such as growth and maturation, which provide critical information in evaluating possible temporal variability in estimated spawning stock biomass in the assessment.

The start year for this assessment is 1948. Given the high likelihood of having unreliable data in early fisheries, choosing a late-starting time for the stock assessment might be an option. I suggest starting the model from 1970 to evaluate the impacts of including data (which are likely to have large uncertainty) prior to 1970 on stock assessment results. The results were similar (Fig. 3).

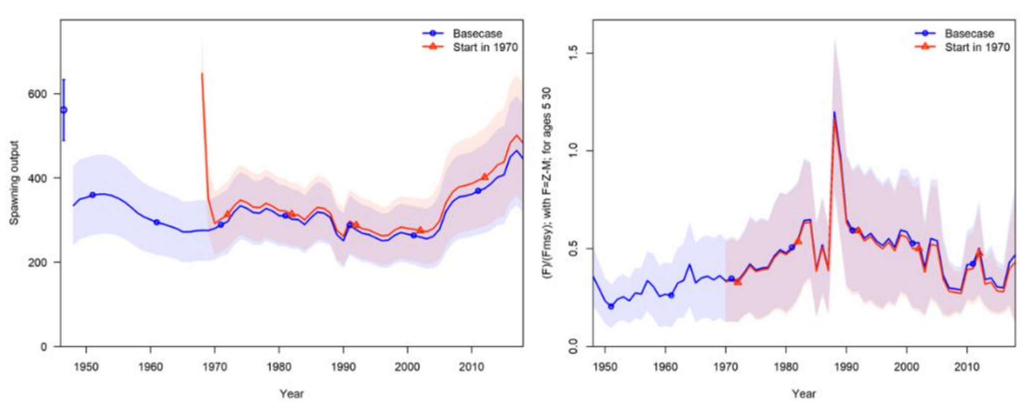

Figure 3: Comparisons of SSB and relative fishing mortality estimates between the model runs starting from the 1948 (base case) and 1970 (sensitivity run).

2. Is the CPUE standardization properly applied and appropriate for this species, fishery, and available data?

Yes, the CPUE standardization was properly applied and appropriate for this species, fishery and available data.

The Assessment Team developed a structured criteria to pre-screen and filter available data to exclude catch records that were not targeting Uku from the CPUE standardization. I believe the structured criteria were well-developed and justifiable. The Assessment Team identified possible temporal-spatial, fishery and environmental variables that might influence CPUEs to be included in the CPUE standardization. The CPUE standardization process is well-structured and followed the best practice guidelines. The data filtering, variable selections, diagnostic analysis to evaluate various statistical assumptions (Maunder and Punt 2004) and modeling approaches (Delta-lognormal GLMMs) were appropriate, and modeling runs were well executed. For a few unconverged CPUE configuration model runs, I would recommend that the Assessment Team document why CPUE standardization failed to converge. The initial concern about the potential impacts of different fishing effort measurements was addressed during the review, yet the choice of fishing effort measurements had little impact. I recommend that the inshore handline CPUE data from 1992 to 2002 be included in the CPUE standardization. Because of possible seasonal patterns in fish catch composition, I also recommend that the interaction between Month:PC (Principal Component) of catch composition be included in future CPUE standardizations. Another possible approach the Assessment Team may explore in the future is using fishing efforts as an offset term during CPUE standardization modeling.

3. Are the assessment models used reliable, properly applied, adequate, and appropriate for the species, fishery, and available data?

Yes, the Stock Synthesis (SS) 3 (V3.30) assessment models used are reliable, properly applied, adequate, and appropriate for this Uku stock assessment.

The 2020 WPSAR Uku Main Hawaiian Islands stock assessment used Stock Synthesis (SS) 3 (V3.30) as a modeling platform. The SS is a standard integrated statistical catch-at-age model. The SS model is capable of incorporating all available CPUE data from different sources and can capture the key life history process and population dynamics of Main Hawaiian Islands Uku. The overall SS model configuration is appropriate. The choices of models used to quantify key life history processes (e.g., growth, maturation, steepness, natural mortality, and weight-length) and fishery processes (e.g., selectivity and catchability) were appropriate. The estimation of selectivities outside the SS model using the length-based SPR model for fishing gear/fleets with little size composition data (i.e., inshore handline, recreational, trolling, and others) is appropriate given the data availability. Jittering was used to evaluate if the initial values led to a global minimal in a maximum likelihood estimation. Proper and comprehensive model diagnostic analysis was conducted. Given that there were only a few observations on both ends of the size distributions (i.e., very small and very large size values), dynamic binning may need to be explored to reduce potential impacts of zero values for the tails of both small and large distributional data.

4. Are decision points and input parameters reasonably chosen?

Yes, decision points and input parameters were reasonably chosen.

The decision to divide the commercial fisheries into different gear/fleets (i.e., deep-sea handline, inshore handline, trolling, and others), develop multiple standardized CPUEs, and reconstruct historical commercial and recreational catches are appropriate and well-justified. The Assessment Team provides sufficient justifications and clear descriptions for the choices of input data and stock assessment model configuration and parameterization. For example, the Assessment team set the selectivity for the deep-sea handline according to estimates in the model, and fixed selectivities for all other gears/fleets. The Assessment Team also conducted a meta-analysis of life history for similar species to estimate the steepness parameter for the Uku and fixed this parameter in the assessment. The natural mortality was also estimated outside the SS3 model using local growth data and was fixed in the assessment. Effective sample sizes for the deep-sea handline size composition data were also well-estimated. The base case scenario was well-selected in the assessment and reflected the best available information. The sensitivity analysis runs included in the assessment considered the uncertainty associated with input data, model configuration, and model parameterization, and were well-defined and justified.

5. Are primary sources of uncertainty documented and presented?

Yes with caveats, the primary sources of uncertainty were documented and presented.

Uncertainties associated with input data, model configuration, and model parameterization were documented and justifications were provided for each specific choice. However, most sensitivity analyses designed to evaluate possible uncertainty associated with input data, model configurations and parameterization only considered one potential source at a time, and limited analysis was conducted to evaluate when multiple uncertainty sources were included at once. Thus, we might have limited understanding of how multiple sources of uncertainty together may influence the stock assessment. However, based on all the sensitivity analyses conducted in the assessment and during the review, it is clear that the stock assessment results and conclusion of the stock status tended to be very stable and robust with regard to their uncertainty of almost all sources. The stability and robustness may result from the use of fixed selectivities for most fishing gear/fleet and fixed values for natural mortality and steepness, which virtually fixed the Uku stock dynamics in the SS3 modeling. The retrospective errors were also identified and considered to be relatively small. However, there is a need to better present the retrospective errors for SSB, F and recruitment estimates following Legault (2009). The current plots of retrospective analysis results in the stock assessment report (Nadon et al. 2020) are difficult to read, and thus make evaluating the magnitude of retrospective errors more challenging as well.

6. Are model assumptions reasonably satisfied?

Yes, the model assumptions were reasonably satisfied and justified.

The assumptions associated with the estimation of key life history parameters and input data were well-documented in the stock assessment report and also evaluated in sensitivity analyses. The stock assessment implicitly assumed that there was no temporal change in catchability q and selectivities. This is unlikely, considering changes in fishing gear, technology and behaviors. However, a sensitivity analysis conducted with varying q (i.e., modeling q as a random walk) suggests no clear impacts on the assessment results (Figure 4).

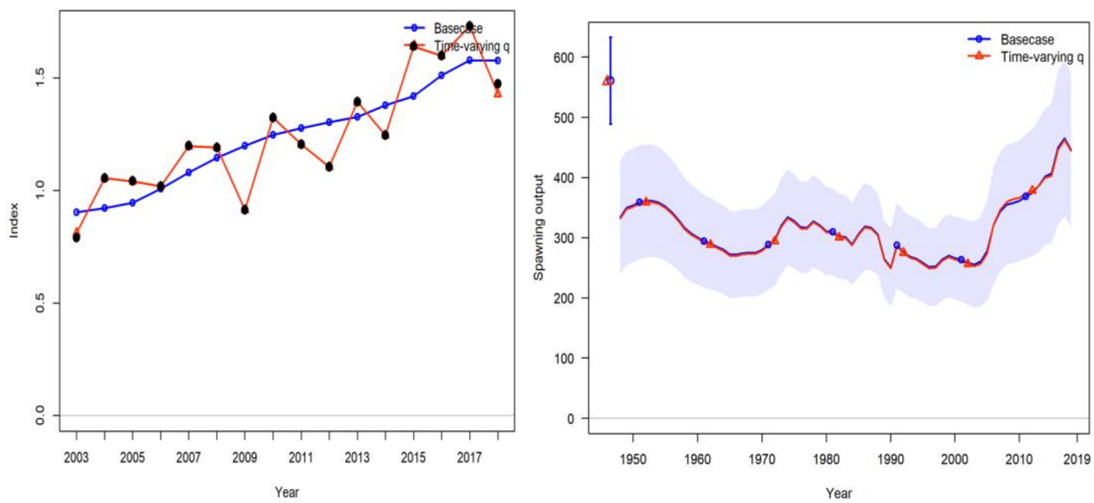

Figure 4: Comparison of the base-case run and sensitivity analysis with a time varying catchability for the deep-sea handline CPUE.

Diver survey selectivity was assumed to be the same as that of the recreational fishery, which needs to be evaluated in the future. However, given that the diver survey index is less informative in a sensitivity analysis conducted during the review (i.e., removing the diver survey index had little impact on the results), this assumption would likely have minimal impacts on the assessment. The assessment also assumed that there is no temporal variability in key life history parameters such as growth and maturation. Although no data were available for evaluating possible temporal changes in growth and maturation, it was concluded that large temporal variability in Uku growth and maturation is unlikely because of relatively low fishing intensity and stable environments.

Selectivity curves were estimated outside the SS3 and were fixed for all gear/fleets except for the deep-sea handline in the assessment. The size composition data for all fishing gear and fleets other than the deep-sea handline were not used in the assessment because of small sample sizes, but the SS3 estimated size compositions for these fisheries can accurately capture the observed size compositions for these fisheries (Fig. 22 in Nadon et al. 2020) even though they were not used in model fitting (Fig. 22 in Nadon et al. 2020). This information suggests the assumed selectivities were suitable in the assessment. The relatively small retrospective errors for SSB, F, and recruitment and good model behavior in model diagnostics also suggest that model assumptions were probably not severely violated.

Given the large number of explicit and implicit biological and statistical assumptions in the assessment, I recommend including a table that summarizes key assumptions and identifies whether these assumptions were evaluated.

7. Are the final results scientifically sound, including but not limited to estimated stock status in relation to the estimated overfishing and overfished status determination criteria (SDC)?

Yes, the final results are scientifically sound in determining stock status.

The base case was well-selected and justified in this assessment, and the assessment results built on the base case are appropriate for determining stock status relative to the SDC. The stock assessment results are robust to the uncertainties associated with both input data quality and quantity, as well as model parameterization and configuration. The robustness of the results may be from the internal consistency of data from different sources within the stock assessment model, stock biomass on the high end of the stock-recruitment relationship, and fixed h, M and selectivities. The robustness shown in the assessment may suggest a high level of confidence in using the base case stock assessment results to determine stock status relative to the SDC. I suggest providing a summary table to summarize key biological reference points from the base case and sensitivity analysis runs, which include F2018, FMSY, F2018/FMSY, SSBMSY, SSBMSST, SSB2018, SSB2018/SSBMSST and CMSY.

8. Are the methods used to project future population state adequate, including the characterization of uncertainty, and appropriately applied for implementation of overfishing limits (OFL)?

Yes with caveats, the methods used to project future population state were adequate, properly included the uncertainty of various sources, and were appropriately applied for implementation of overfishing limits.

Uku stock projections were made using an age-structured model AGEPRO (Brodziak et al. 1998). The projection model was conditioned on base model outputs. The uncertainty associated with stock assessment outputs were incorporated by conducting 100 bootstrap runs and 1000 total simulations for each bootstrap run. Three scenarios were incorporated for recruitment dynamics in the projection. They include recent short-term recruitment (20%), long-term recruitment (20%), and a Beverton-Holt recruitment model (60%) used in the assessment with an added variability term (Brodziak et al. 1998). I believe this composite recruitment dynamics capture the most important uncertainty within the projection. I requested an additional projection run during the review to evaluate the worst possible scenario with the recruitment in the projection randomly drawing from the lower 25 percentiles of historical recruitment. This represents the use of the worst historical recruitment in the projection, and may address concerns that the current recruitment dynamics used in the projection may be relatively optimistic considering high recruitment levels in recent years. I also suggest using composite selectivity, instead of using only deep-sea handline selectivity, weighted by catch contribution of each gear/fleet in the base case projection to reflect the nature of having multiple fishing gears/fleets in the Uku fishery. Thus, the composite selectivity used in projecting future catch is set to be the selectivities of all gears/fleets weighted with the average proportion of their catch in 2016-2018: deep-sea handline - 27% of catch, inshore handline - 6% of catch, trolling + others - 12% of catch, and recreational - 54% of catch. The projection in this assessment extends to 2026, but I recommend that an updated assessment be conducted in three years considering the increase in CPUE and SSB and possible uncertainty associated with recreational data.

9. Can the results be used to address management goals stated in the relevant FEP or other documents provided to the review panel? If any results of these models should not be applied for management purposes with or without minor short-term further analyses (in other words, if any responses to any parts of questions 1-8 are "no"), indicate: Which results should not be applied and describe why, and Which alternative set of existing stock assessment results should be used to inform setting stock status and fishery catch limits instead and describe why.

Yes, the results derived from the base case stock assessment can be used to address management goals in the relevant FEP.

The base case stock assessment identified and developed by the Assessment Team provides the best available information for the Hawaiian Islands Uku stock dynamics. Although my answers to several TORs include a few "yes, with caveats", the overall quality of this stock assessment is high and the conclusion for the stock status and management recommendations made on the base case assessment are robust to the uncertainties associated with data quality and quantity, model configurations and parameterizations, and biological/statistical assumptions made in assessment modeling. Thus, I conclude that the base case stock assessment results can be used to address management goals for the MHI Uku fishery.

10. As needed, suggest recommendations for future improvements and research priorities. Indicate whether each recommendation should be addressed in the short/immediate term (2 months), mid-term (3-5 years) and long-term (5-10 years). Also indicate whether each recommendation is high priority (likely most affecting results and/or interpretation), mid priority, or low priority.

SHORT-TERM RESEARCH

Recommendations that can be addressed in the short/immediate term. All the recommendations for the short/immediate term should be considered as HIGH priority and were made for improving this year's stock assessment. I expect these changes will be incorporated into the final stock assessment.

<u>For improving presentations and documentations</u>:

- Add an additional section to outline recommendations from the 2016 stock assessment review, and describe how these recommendations are addressed and incorporated into this assessment, or why the recommendations are not considered in this assessment.

<u>Provide additional figures</u>:

- Time series of catch data by gear/fleet for the whole stock assessment time period from 1948 to 2018,

- Time series of standardized CPUEs by gear/fleet using “fishing day” and “fishing hour” for 2003 – 2018 to compare possible differences in CPUEs measured with “fishing day” and “fishing hour”,
- Size at age data with colored dots from MHI and NWHI,
- Addition of Mohn’s rho values for recruitment, SSB, and F in the retrospective analysis plot,
- Diver survey locations for each survey year,
- Fishing mortality time series by gear/fleet from 1948 to 2018.

Provide additional tables:

- Key biological and statistical assumptions used in stock assessment modeling, as well as a key to sections of the report.
- Summary table for biological reference points/management statistics for base case and sensitivity analysis runs including F2018, FMSY, F2018/FMSY, SSBMSY, SSBMSST, SSB2018, SSB2018/SSBMSST and CMSY.

Provide additional sensitivity analyses on (single change only):

- Using Lorenzen natural mortality M for age-specific natural mortality rates,
- Using a single deep-sea handline CPUE from 1948 to 2018 with “fishing days” as an effort measurement,
- Using extended inshore handline CPUE from 1992 to 2018 with “fishing days” as a fishing effort measurement,
- Starting the stock assessment model from 1970 to evaluate the impacts of including data (which are likely to have large uncertainty) prior to 1970 on stock assessment results,
- Setting sigma R as a parameter to be estimated in the model (i.e., sigmaR was not fixed),
- Assuming a time varying catchability from 2003 to 2018 for the deep-sea handline to evaluate the sensitivity of a varying q on stock assessment,
- Using iterative effective sample sizes for size composition data in modeling fitting.

Provide the projection:

- Using composite selectivities of different gear/fleet weighted by their catches as the base case projection,
- Including a worst-case scenario with recruitment being randomly sampled from the lower 25th percentile of historical recruitments and composite selectivity. This projection does not replace the base-case projection, but rather provides an alternative scenario for the projection under poor recruitment.

MID-TERM RESEARCH

- Conduct additional sensitivity analyses considering combined changes in a more broad range of steepness h and natural mortality M values to evaluate possible impacts of fixing both M and h to the stability of stock assessment. Mangel et al. (2013) suggest that if M and h are fixed in a stock assessment, the whole assessment is predetermined by these typically "guessed" h and M values. It is important to identify whether the super-stability of the Uku stock assessment is a result of fixed h and M values within the assessment. It may also be interesting to include fixed selectivity in this analysis (HIGH).
- Explore inclusion of Lorenzen M, a single time series of deep-sea handline CPUEs, and extended inshore CPUE as a possible base case scenario (HIGH).
- Include the interaction between Month:PC (Principal Component) of catch composition in future CPUE standardizations to address possible seasonal changes in catch composition (MED).
- Use fishing efforts as an offset term during CPUE standardization modeling (MED).
- Continue key life history studies including updating maturity ogives, examining fecundity, and evaluating changes in sex ratio with length (MED).
- Continue samples for ageing to better understand spatial variability in growth (LOW).
- Continue BFish program to develop a fishery-independent program (HIGH).
- Better understand changes in fleet dynamics in the context of how they relate to improved technology and information-sharing among fishermen to better inform temporal variability in q (MED).
- Continue close collaboration with NMFS recreational scientists to improve recreational data quality (HIGH).
- Design and conduct a simulation study to evaluate and optimize recreational survey design. This can be done using historical data to simulate an Uku recreational fishery, and then applying different monitoring strategies to sample this simulated recreational fishery and identify a monitoring program that is most cost-effective and yields the highest quality of data (e.g., Cao et al. 2014, Li et al. 2019) (HIGH).
- Continue directly working with MRIP survey statisticians for the stock assessment in identifying and including high quality of recreational data (HIGH).
- Identify active fishermen interested in providing feedback after the mail survey with an in-depth interview that will provide key information to understanding what factors may potentially influence data quality (MRFSS) (HIGH).
- Continue collecting biological samples, including otoliths, for future life history studies (LOW).
- Evaluate changing fleet dynamics with new technologies and gears to better understand temporal changes in catchability and advise model configuration and parameterization (MED).

- Explore robust likelihood functions (Chen et al. 2000, 2003) to reduce the impact of outliers in catch data, size composition data, and survey abundance index data (MED).
- Explore Bayesian approaches to fully incorporate uncertainty in the assessment (MED).
- Keep the assessment model structure and configuration relatively stable over time and run future models in parallel with the old model to identify changes in stock assessment results resulting from changes in model configurations (MED).
- Better quantify differences in assessment results between the base case and sensitivity scenarios (MED).

LONG-TERM RESEARCH

- Improve understanding of stock structure, connectivity, and adult movement via genetic stud tagging study (MED).
- Examine distribution of spawning grounds and dynamics of spawning aggregations (HIGH).
- Continue to improve data quality of fishery-dependent, fishery-independent and life history data (HIGH).
- Develop potential "study fleets" to train interested commercial fishermen in data collection, then compare their statistics to those of fishermen not participating in a "study fleet" to cross-check data quality for commercial fisheries (MED).
- Better understand stock structure (MED).
- Develop a target fishing mortality in the Uku fishery management to act as an early warning to avoid overfishing. Currently F_{MSY} is set as MFMT which determines if overfishing occurs. I recommend that a fishing mortality lower than MFMT be explored as the management target F (MED).

11. Draft a report (individual reports from each of the panel members and an additional Summary Report from Chair) addressing the above TOR questions.

This report is prepared according to instructions detailed in the Performance Work Statement. All TORs are addressed. I also helped the Review Panel Chair develop the Summary Report. The draft Summary Report was presented to the PIFSC, WASAP, and WPFMC on the last day of the review (February 28, 2020).

V. Conclusions and Recommendations

Overall, based on the stock assessment presented and additional runs conducted during the review, I believe that the assessment results and Uku stock status determination are robust regarding various uncertainties in data, parameters and assessment models. The 2020 benchmark stock assessment concludes that the MHI Uku stock is currently NOT undergoing overfishing and is NOT overfished. Comprehensive sensitivity analyses suggest that this conclusion is rather robust regarding uncertainty data and stock assessment models. The assessment is scientifically sound and adequately addresses management needs. I recommend that the stock assessment results for the base case scenario identified by the Assessment Team be used for providing management advice. I provide a list of short-term research recommendations that the Assessment Team may consider should they rework the draft Uku stock assessment report. These short-term recommendations mainly include providing additional tables and figures to better document, present and summarize data and stock assessment results; conducting additional sensitivity analysis to evaluate alternative input data and model configuration and parameterization; and improving model projections to better capture assessment uncertainty. I believe these recommendations can greatly improve this MHI Uku benchmark stock assessment. I also provide the mid-term and long-term research recommendations for further improving the quality of recreational catch data and life history parameter estimates, exploring more alternative model configurations and parameterizations, and better understanding temporal variability in the fishery. My specific short-, mid-, and long-term research recommendations/comments can be found in TOR 10.

VI. References

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Presentations given during the review

- Bottomfish Fishing in Hawaii: Overview of Fishing Vessels, Gear, and Practices
- Brief introduction to Uku and its fishery
- Uku Management Perspective
- History of the Hawaiian Islands Uku stock assessments
- 2020 benchmark stock assessment of the Hawaiian Islands Uku fishery
- Results for additional information, analysis, and model runs requested by the Review Panel

Appendix 2. Performance Work Statement

Performance Work Statement (PWS)

National Oceanic and Atmospheric Administration (NOAA)

National Marine Fisheries Service (NMFS)

Center for Independent Experts (CIE) Program

External Independent Peer Review

2020 Benchmark Stock Assessment for Main Hawaiian Islands Uku

Background

The National Marine Fisheries Service (NMFS) is mandated by the Magnuson-Stevens Fishery Conservation and Management Act, Endangered Species Act, and Marine Mammal Protection Act to conserve, protect, and manage our nation's marine living resources based upon the best scientific information available (BSIA). NMFS science products, including scientific advice, are often controversial and may require timely scientific peer reviews that are strictly independent of all outside influences. A formal external process for independent expert reviews of the agency's scientific products and programs ensures their credibility. Therefore, external scientific peer reviews have been and continue to be essential to strengthening scientific quality assurance for fishery conservation and management actions.

Scientific peer review is defined as the organized review process where one or more qualified experts review scientific information to ensure quality and credibility. These expert(s) must conduct their peer review impartially, objectively, and without conflicts of interest. Each reviewer must also be independent from the development of the science, without influence from any position that the agency or constituent groups may have. Furthermore, the Office of Management and Budget (OMB), authorized by the Information Quality Act, requires all federal agencies to conduct peer reviews of highly influential and controversial science before dissemination, and that peer reviewers must be deemed qualified based on the OMB Peer Review Bulletin standards.
(http://www.cio.noaa.gov/services_programs/pdfs/OMB_Peer_Review_Bulletin_m05-03.pdf).

Further information on the CIE program may be obtained from www.ciereviews.org.

Scope:

A single species stock assessment of the uku snapper (*Aprion virescens*) was conducted for the Main Hawaiian Islands and presented in an assessment report. A previous stock assessment for uku was conducted in 2017 using a data-limited length-based approach. The 2020 benchmark assessment diverges significantly from this previous work as it implements the first integrated stock assessment of a domestic stock in the U.S. Pacific Region. This integrated assessment uses the Stock Synthesis (v 3.30) framework to integrate CPUE indices, size frequency, diver survey, and catch data into a single age-structured model. This integrated model was used to estimate biomass and stock status through time, and stock status was evaluated against MSY-based reference points described in the Fishery Ecosystem Plan for the Hawaii Archipelago. Projections were provided to inform management setting of acceptable biological catch and annual catch limits. The specified format and contents of the individual peer review reports are found in **Annex 1**. The Terms of Reference (TORs) of the peer review are listed in **Annex 2**. Lastly, the tentative agenda of the panel review meeting is attached in **Annex 3**.

Requirements:

NMFS requires two reviewers who are external to PIFSC, Pacific Islands Regional Office (PIRO), and the Western Pacific Regional Fishery Management Council and its affiliated bodies to conduct an impartial and independent peer review in accordance with this PWS, OMB Guidelines, and the TORs in Annex 2.

CIE reviewers shall have:

- Working knowledge and recent experience in the application of stock assessment models, including integrated models, sufficient to complete a thorough review;
- Knowledge of integrated assessment models, more specifically Stock Synthesis;
- Expertise with measures of model fit, identification, uncertainty, forecasting, and biological reference points;
- Familiarity with federal fisheries science requirements under the Magnuson-Stevens Fishery Conservation and Management Act;
- Familiarity with local Pacific Islands fisheries as well as artisanal fisheries and fishing practices;
- Excellent oral and written communication skills to facilitate the discussion and communication of results.

Tasks for Reviewers:

Each of the CIE reviewers shall complete the following tasks in accordance with the PWS and Schedule of Milestones and Deliverables.

<u>Pre-review Background Documents</u>: No later than two weeks before the peer review, the NMFS Project Contact will provide reviewers the necessary background information and reports for the peer review. The reviewers shall read all documents prior to the peer review in accordance with the PWS scheduled deadlines.

Required pre-review documents:

- DRAFT 2020 uku assessment: Nadon *et al*. Stock assessment of uku in Hawaii, 2020. NOAA Tech Memo.
- Previous reef fish stock assessment: Nadon, M. O. 2017. Stock assessment of the coral reef fishes of Hawaii. U.S. Dep. Commer., NOAA Tech. Memo., NOAA-TM-NMFS-PIFSC-60, 212p. (focus on sections pertaining to uku)

- Independent peer review report for Nadon (2017) stock assessment: Benchmark review of the 2016 stock assessment of the Main Hawaiian Islands Reef-associated Fish. Consensus Review Panel Report. 27 p.
- Hawaii Fishery Ecosystem Plan: Western Pacific Regional Fishery Management Council. 2009. Fishery Ecosystem Plan for the Hawaii Archipelago. Only section 5.2 (p. 133-138) and section 5.3 (pp 138-143).
- Methot, R.D. and Wetzel,C. 2013. Stock synthesis: A biological and statistical framework for fish stock assessment and fishery management. *Fisheries Research* 142: 86-99.
- Winker et al. 2014. Proof of concept for a novel procedure to standardize multispecies catch and effort data. *Fisheries Research* 155: 149-159.

Panel Review Meeting: Each CIE reviewer shall conduct the independent peer review in accordance with the PWS and TORs, and shall not serve in any other role or represent any of their organizations in this capacity. Each CIE reviewer shall actively participate in a professional and respectful manner as a member of the meeting review panel, and their peer review tasks shall be focused on the TORs. The NMFS Project Contact is responsible for any facility arrangements (e.g., conference room for panel review meetings or teleconference arrangements). NMFS will provide a Chair for this in-person panel review. The NMFS Project Contact is responsible for ensuring that the Chair understands the contractual role of the CIE reviewers.

Contract Deliverables - Independent Peer Review Reports: Each reviewer shall complete an independent peer review report in accordance with the PWS. Each reviewer shall complete the independent peer review according to required format and content as described in Annex 1. Each reviewer shall complete the independent peer review addressing each TOR as described in Annex 2. Reviewers are not required to reach a consensus.

Other Tasks – Contribution to Summary Report: This Benchmark Review consists of two CIE reviewers and one review Chair which is not provided by the CIE. Each CIE reviewer will assist the Chair with contributions to a Summary Report that will describe the majority or consensus findings, based on the TORs of the review. Each individual CIE reviewer is not required to report a consensus finding. Reviewers should provide a brief synopsis of their own views on the summary findings and conclusions reached by the review panel in accordance with the TORs.

Foreign National Security Clearance

When reviewers participate during a panel review meeting at a government facility, the NMFS Project Contact is responsible for obtaining the Foreign National Security Clearance approval for reviewers who are non-US citizens. For this reason, the reviewers shall provide requested information (e.g., first and last name, contact information, gender, birth date, passport number, country of passport, travel dates, country of citizenship, country of current residence, and home country) to the NMFS Project Contact for the purpose of their security clearance, and this information shall be submitted at least 50 days before the peer review in accordance with the NOAA Deemed Export Technology Control Program NAO 207-12 regulations available at the Deemed Exports NAO website: http://deemedexports.noaa.gov/ and http://deemedexports.noaa.gov/compliance_access_control_procedures/noaa-foreign-nationalregistration-system.html. The contractor is required to use all appropriate methods to safeguard Personally Identifiable Information (PII).

Place of Performance:

Each reviewer shall conduct an independent peer review during the panel review meeting scheduled in Honolulu, Hawaii at the Finance Factors Building, 164 Bishop St #140, Honolulu, HI 96813, during **February 24– 28, 2020**.

Period of Performance

The period of performance shall be from the time of award through **April 2020**. Each reviewer's duties shall not exceed 14 days to complete all required tasks.

Schedule of Milestones and Deliverables: The contractor shall complete the tasks and deliverables in accordance with the following schedule.

Schedule	**Milestones**
Within two weeks of award	Contractor selects and confirms reviewers
No later than two weeks prior to the review	Contractor provides the pre-review documents to the reviewers
February 24 – 28, 2020	**Panel review meeting**
Within three weeks of the panel review meeting	Contractor receives draft reports
Within 2 weeks of receiving draft reports	Contractor submits final reports to the Government

Applicable Performance Standards

The acceptance of the contract deliverables shall be based on three performance standards:

(1) The reports shall be completed in accordance with the required formatting and content; (2) The reports shall address each TOR as specified; and (3) The reports shall be delivered as specified in the schedule of milestones and deliverables.

Travel

All travel expenses shall be reimbursable in accordance with Federal Travel Regulations (http://www.gsa.gov/portal/content/104790). International travel is authorized for this contract.

Restricted or Limited Use of Data

The contractors may be required to sign and adhere to a non-disclosure agreement.

Annex 1: Peer Review Report Requirements

1. The report must be prefaced with an Executive Summary providing a concise summary of the findings and recommendations.
2. The report must contain a background section, description of the individual reviewers' roles in the review activities, summary of findings for each TOR, in which the weaknesses and strengths are described, and conclusions and recommendations in accordance with the TORs.
3. Reviewers must describe in their own words the review activities completed during the panel review meeting, including a brief summary of findings, of the science, conclusions, and recommendations.
4. Reviewers should discuss their independent views on each TOR even if these were consistent with those of other panelists, but especially where there were divergent views.
5. Reviewers should elaborate on any points raised in the summary report that they believe might require further clarification.
6. Reviewers shall provide a critique of the NMFS review process, including suggestions for improvements of both process and products.
7. The report shall be a stand-alone document for others to understand the weaknesses and strengths of the science reviewed, regardless of whether or not they read the summary report. The report shall represent the review of each TOR by each individual reviewer, and shall not simply repeat the contents of the summary report.
8. The report shall include the following appendices:

Appendix 1: Bibliography of materials provided for review

Appendix 2: A copy of this Statement of Work

Appendix 3: Panel membership or other pertinent information from the panel review meeting.

Annex 2: Terms of Reference for the Peer Review

Terms of Reference for the Peer Review

*2020 Benchmark Stock Assessment for Main Hawaiian Islands Uku (*Aprion virescens*)*

External Independent Peer Review under the Western Pacific Stock Assessment Review framework: 2020 Benchmark Stock Assessment for Main Hawaiian Islands Uku

For questions 1-8 and their subcomponents, reviewers shall provide a "yes" or "no" answer and will not provide an answer of "maybe". Only if necessary, caveats may be provided to these yes or no answers, but when provided they must be as specific as possible to provide direction and clarification to NMFS.

1. Of the data considered for inclusion in the assessment, were final decisions on inclusion/exclusion of particular data appropriate, justified, and well-documented?
2. Is the CPUE standardization properly applied and appropriate for this species, fishery, and available data?
3. Are the assessment models used reliable, properly applied, adequate, and appropriate for the species, fishery, and available data?
4. Are decision points and input parameters reasonably chosen?
5. Are primary sources of uncertainty documented and presented?
6. Are model assumptions reasonably satisfied?
7. Are the final results scientifically sound, including but not limited to estimated stock status in relation to the estimated overfishing and overfished status determination criteria (SDC)?
8. Are the methods used to project future population state adequate, including the characterization of uncertainty, and appropriately applied for implementation of overfishing limits (OFL)?
9. Can the results be used to address management goals stated in the relevant FEP or other documents provided to the review panel? If any results of these models should not be applied for management purposes with or without minor short-term further analyses (in other words, if any responses to any parts of questions 1-8 are "no"), indicate:
    a. Which results should not be applied and describe why, and
    b. Which alternative set of existing stock assessment results should be used to inform setting stock status and fishery catch limits instead and describe why.
10. As needed, suggest recommendations for future improvements and research priorities. Indicate whether each recommendation should be addressed in the short/immediate term (2 months), mid-term (3-5 years) and long-term (5-10 years). Also indicate whether each recommendation is high priority (likely most affecting results and/or interpretation), mid priority, or low priority.

11. Draft a report (individual reports from each of the panel members and an additional Summary Report from Chair) addressing the above TOR questions.

Annex 3: Tentative Agenda

External Independent Peer Review under the Western Pacific Stock Assessment Review framework:

2020 Benchmark Stock Assessment for Main Hawaiian Islands Uku

Western Pacific Regional Fishery Management Council Office

1164 Bishop St., Suite 1400; Honolulu, HI 96813

February 24 - 28, 2019, 9am - 5pm

Day 1, Monday February 24

1. Welcome and Introductions
2. Background information – Objectives and Terms of Reference
    a. Fishery Operation
    b. Fishery Management
3. History of stock assessments and reviews
4. Data
    a. Hawaii Division of Aquatic Resources Fishing Report System (FRS) and Hawaii Marine Recreational Fishery Survey (HMRFS)
    b. Life history information
    c. Other
5. Presentation and review of stock assessment

Day 2, Tuesday February 25

6. Continue presentation and review of stock assessment

Day 3, Wednesday February 26

7. Continue review of stock assessment

Day 4, Thursday February 27

8. Continue review of stock assessment

9. Public comment period
10. Panel discussions (closed)

Day 5, Friday February 28

11. Continue panel discussions (closed, morning)
12. Present panel results (afternoon)
13. Adjourn

Order of agenda items may change. Meeting may run late if needed to accommodate all agenda items.

Appendix 3. List of Participants

WPSAR panel: Erik Franklin (WPRFMC SSC and University of Hawaii), Yan Jiao (VT, CIE), Yong Chen (UM, CIE)

WPSAR Coordinating Committee: Marlowe Sabater (WPRFMC), Bret Schumacher (NOAA PIRO), John (Syslo (NOAA PIFSC),

Stock Assessment Team: Marc Nadon (NOAA PIFSC), Michelle Sculley (NOAA PIFSC), Felipe Carvalho (NOAA PIFSC),

Attendees: Joe O'Malley (NOAA PIFSC), Hongguang Ma (NOAA PIFSC), Roy Morioka (public, fisher), Bryan Ishida (Hawaii DAR), Beth Lumsden (NOAA PIFSC), Todd Jones (NOAA PIFSC)